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ABSTRACT

A summer science camp was held in Korea for 30 ninth grade students gifted in science. Students were divided into three groups (physics, chemistry, and biology) for activities which included problem solving, brainstorming, and experimental work. The experiments of the physics group addressed the use of solar energy, the chemistry group focused on prevention of water pollution, and the biology group explored ways to increase food production. Among characteristics of participating students were high mean IQ and creativity, good general health, and homes with television sets and radios. Students evaluated themselves in terms of their problem solving experiences, social life experiences at the camp, and experimental activities. The physics, biology, and chemistry teachers also related their perceptions of participating students. The original purposes of the camp were to enhance students' creativity and accelerate learning through problem solving, as well as to train teachers in gifted education. A working schedule of activities for each of the groups is appended. (SB)

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A Report on the Science Summer Camp for the Gifted 9th Grade Students

January, 1982

The Board of Education
Kyeonggi-Province
Suweon, R.O.K.

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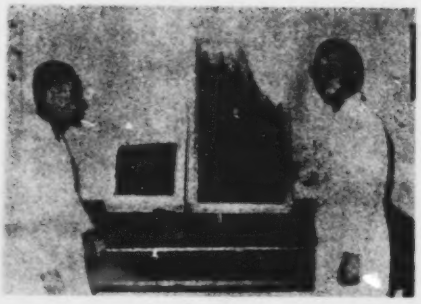
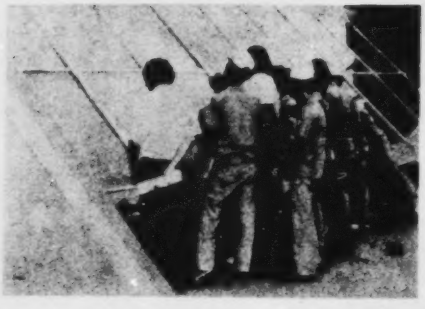


physics group

chemistry group

biology group

brain storming



on spot study at a solar house

visit tour to the KAIST

Foreword

A summer science camp for the 9th grade gifted students was organized as an out-of-school activity from Aug. 17 to 27, 1981 at the Suwon Students Science Center, Suwon, Korea. This was the first attempt in Korea as a gifted education.

The main purposes of the camp were to enhance the creativity of the gifted students and to accelerate their science learning. Thirty participants had been selected as science gifted students out of 45,000 9th grade students throughout the Kyung-gi province, and five secondary school teachers had been appointed as instructors of the camp. The programme organizers, managers for the programme were three science professors(physics, chemistry and biology) of the Seoul National University.

The participants were devided into three groups: Physics, chemistry and biology. Each group was given one theme to study at the camp. With 10 days program, the participants had wonderful, exciting experiences in learning science and, at the same time, solved successfully the given problems in their own original way.

In the final day, not only staffs but also participants had concluded that the camp was very successful in the gifted education and similar camps should be organized in the following years.

This report is prepared to circulate what we learned from the first attempt on the science gifted education in Korea.

Chung Yun Tai
Professor
Department of Physics Education
College of Education
Seoul National University

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1. The camp: Background and arrangements

The Science summer camp for the gifted students was proposed by Professor Chung Yun Tai. He met with Mr. Lee Joon Kyeng, Superintendent, Board of Education and Mr. Hong Kee Pyo, Director of Kyung-gi Students Science Center. A science summer camp with the following purposes was recommended by Prof. Chung.

1) To enhance the creativity of science gifted students and promote their science learning capacity.

2) To identify the characteristics of the science gifted students.

3) To train teachers for gifted education.

4) To demonstrate the indispensibility of special education for science gifted students at schools.

The authorities, mentioned above, welcomed the proposals of a science summer camp and kindly allocated the special funds for the expenditure.

The camp was sponsored by the Students Science Center from August 17 to 27, 1981, Suwon, Korea.

Staffs

Professors : Chung Yun Tai(physics), Paik Myeng Hyen(chemistry), Kim Joon Min(biology).

Instructors : Kwon Kee Joon(physics, Yuo-joo Agricultural high school), Kim Jong Hee(chemistry, Su-sung high school), Song Yung Sik (biology, Su-sung high school), Lee Jun(recreation, An-yang technical high school), Mrs. Lee Hyun Yung(meal, Gong-do middle school) and Hwang Hyen Mok, Song Yong Dai, Song Jong Jin(Students Science Center).

Orientation

At the planning stage of the camp, the instructors had intensive orientation in connection with the characteristics of science gifted students and creative thinking through brain storming by Dr. Chung Won Sik, Dean of College of Education, SNU, education psychologist. After that, professors and instructors had made cooperatively concrete working plans of the camp.

Selection of participants

The participants of the camp were selected by the following procedures

1) Preliminary survey

Seventy five students among the 9th grade students from 268 middle schools in Kyung-gi province was chosen as the candidate. The criteria of the selection was two fold.

a) One must have 90 or better in science and mathematics test.

b) IQ must be over 136.

2) Principals' recommendation

Recommendation of school principals for the students, mentioned above, was asked for. The number of students recommended by the principals were 57.

3) Selection procedure by the Organizing Committee

As a final step, Organizing Committee selected 30 students as science gifted students to participate in the camp. Followings were main consideration as criteria of the selection:

a) Evaluation of personality judged by students' record of middle schools.

b) Parents' job and their concern in the students' education.

c) Participation in various kinds of out-of-school science

activities : such as students' science fair, students' science contest.

d) Score of IQ.

Programme operation

1) In the programme of learning activities, each group of 10 participants was given one problem to solve via group work.
The followings were the topics

a) How to make use of solar energy ... Physics group

b) How to prevent water pollutions ... Chemistry group

c) How to increase food productions ... Biology group

2) In the problem solving session, the group recalled, re-organized their knowledge and experiences in connection with the problem.
In case of need, they were given instructions by teachers and professors.
When necessary, they had on-the-spot study and survey.

3) In the brain storming sessions, all participants were asked to submit their original, new ideas related to the problem solving.
With these fresh ideas, the group set up their work plan by putting together and re-arranging the ideas.

4) In accordance with the work plan, the group work included experiments, field survey, on-the-spot study, survey of reference materials, consultation of qualified resource persons and other possible activities. These were performed individually or as group activities.

5) During the group work, the teacher or professor took the roll only as an advisor or guid, and never gave the judgement, right or wrong, to their work. If necessary, the teacher gave lectures on the topics of high school level or above.

6) All participants were made a tour to the Seoul National University and Korean Advanced Institute for Science and Technology.
A special lecture, "Science and Technology in the future" was given by Professor of physics, Dr. Kim Jung Hyum, Korea University. After the tour and special lecture, participants were asked to submit written

comments on their experiences.

7) In the process of problem solving, group activities were the main vehicles. Original ideas by individuals were, however, welcomed and individual work were encouraged.

8) Each participant was asked to submit his own report on the results of experiments and works. At the final meeting of the camp, students selected as a representative of each group presented a speech on the group work to audiences gathered from the Kyung-gi province who were mostly science teachers, principals and science supervisors.

Evaluation procedure

Through out the camp there was no written test. The evaluation of students' achievements was made by students' works, reports and teachers' observation records.

2. Reports of sub-groups

Physics group

Topic : How to use solar energy effectively.

(Introduction)

We are now facing with serious energy shortage problems. Useful energy resources are expected to be exhausted in the near future. In addition to this, there arises a serious pollution problems that comes with the consumption of energy. Therefore it is necessary to exploit new energy sources with inexhaustible supply and with no pollution problems.

At present, solar energy is highlighted as new energy sources for mankind. However, the utilization efficiency of solar energy is less than 40%. Accordingly we are going to study the way to make an utilization efficiency of solar energy higher.

(Experiments)

1) Outcomes of the brain storming sessions

a) Solar furnance, solar cell, solar house and electric generation with solar energy etc. are the way of utilization of solar energy. The utilization method and features, efficiencies of each scheme, mentioned above, are quite different.

b) Among the methods mentioned above, the efficiency of solar house is the highest and it can be applied to our every day life. For this reason, the group thought that it is best to device a new type of collecting plate of solar energy for solar houses.

c) Problems arising in solar houses

(1) Energy density on a solar house is too small

(2) Height of sun is varing seasonally and hourly

(3) Climate and configuration of ground could become unfavorable for utilization of solar energy. At night, there is no solar energy available.

(4) Almost half of sun light have been scattered before reaching the ground.

(5) There would be some difficulties to keep heat energy for long period of time.

(6) There would be some energy loss by means of heat conduction, convection and radiation at the collecting plate.

d) Methods to increase the efficiency

(1) Should follow the sun so that maximum amount of sun light can be received.

(2) Should decrease the reflecting energy from collecting plate.

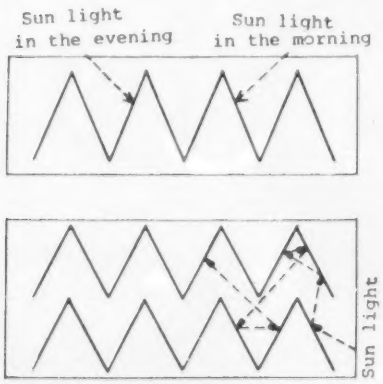
(3) Should use the energy scattered by collecting plate.

(4) Should utilize convection of air, if possible.

(5) Should prevent the heat loss by means of conduction, convection and radiation at collecting plate.

(6) It is impossible to eliminate the effect of climate and configuration of ground.

e) Solutions developed



(1) Zig-zag pins are equipped across the pipes at the collecting plate to absorbs the sun light maximumally as sun moves around.

(2) By means of adjusting the distances between two pins, it is possible to intercept the reflecting energy and make use of scattered rays.

(3) If light falls on the front side of the pins, the rear side will emit heat energy. It is better the pins are heated indirectly, by air.

(a) Punch holes for convection of air at near the peak of the pins and a hole for pipes at the center.

(b) Hang pipes through holes of pins so that it may be heated indirectly by air.

(4) Method for preventing the heat loss by means of conduction, convection and radiation.

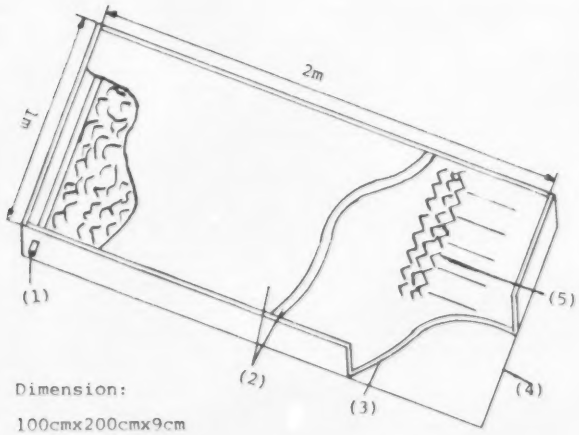
(a) Materials for sides and bottom of collecting plate should be insulator.

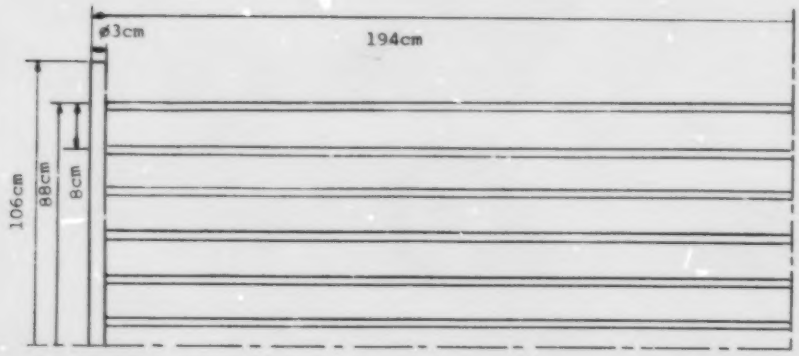
(b) Silver foil is covered on the insulating materials and back side of the bottom is painted with white color.

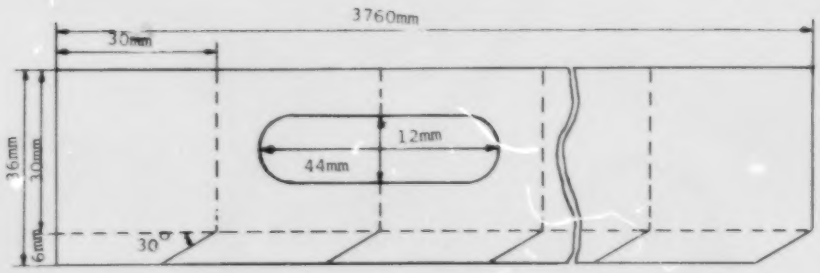
(c) Front of collecting plates is covered with double glazed window.

(d) Pins as well as pipes are coated with un-polished selective paint.

(f) Design of collecting plate.







(Method of experiments)

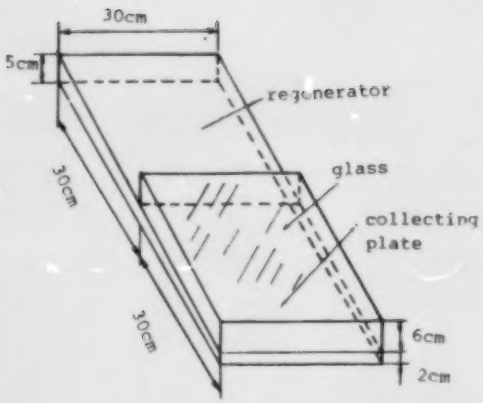
1) A model collecting plate about 1/4 size of a real plate has been set up for experiments.

2) Model collecting plate pins of the real size has been set up. The picture shows the dimension.

3) Tanks of two models are filled with water.

4) The temperature before the experiments started was measured with thermometer.

5) Set up a 400 Watt electric bulb at 20cm above the center of the collecting plate with angle of 30°. Measure the temperature per 20-



minutes for 100 minutes. (The clouded weather prevented the group from using the sun light.)

6) Measure the temperature rise of water at the tanks at given time interval and plot a graph.

7) The group found the efficiency difference between two models by means of calculating the collecting energy per unit area per minute of each model.

Water : 6,800cc, area of collecting plate: 900cm^2

(Data of experiment and result)

Model \ Initial Temp. \ Minutes			20	40	60	80	100
Model of collecting plate	23.7°C	(°C) Temp.	25.1	26.4	27.9	29.0	30.9
		(°C) Temp. rise	1.4	2.7	4.2	5.3	6.5
Model of collecting plate with pins	24.0°C	(°C) Temp.	25.5	27.0	28.5	29.8	31.6
		(°C) Temp. rise	1.5	3.0	4.5	5.8	6.9

1) Total heat received during 100 minutes at the collecting plates = 1 cal/g°C x 6.5°C x 6,800g

= 44,200 cal

2) Total heat received during 100 minutes at the collecting plates with pins = 1 cal/g^{o}C x 6.9^{o}C x 6,800g

= 46,920 cal

3) Heat energy per unit area, per 1 minute at collecting plate

= 44,200 cal 900cm^{2} ÷ 100 minutes

= 0.49 cal/cm^{2}. min

4) Heat energy per unit area, per 1 minute at collecting plate with pins = 46,920 cal ÷ 900cm^{2} ÷ 100 minutes

= 0.52 cal/cm^{2}. min

5) The efficiency of collecting plate with pins is 0.03 cal/cm^{2}. min higher than that of regular collecting plate.

(Discussion)

1) Efficiency of the collecting plate with zig-zag pins is somewhat higher than that of collecting plate without pins. So it is desirable to equip with zig-zag pins in order to make use of solar energy more effectively.

2) The group wanted to have experiment with solar energy, but, because of cloudy day and time limit, had done with electric lamp. In order to compare the efficiency of two models, the group thought that there would be no difference between solar ray and electric light.

3) At the brain storming sessions, one submitted an idea that the heat exchanger can use the freon gas in a refrigerator. Unfortunately, this idea couldn't be tested in this time.

Chemistry group

Topic : How to prevent water pollution

(Preface)

The 70% of human body consists of water. If thirsty, we want water. The plants also need water to live with. Water is indispensible to all forms of life.

Recently, water becomes polluted seriously. If we leave this problem unsettled, water pollution will do harm to men and other living things. The group discussed this matter intensively. By putting together and re-arranges the idea submitted at brain storming sessions, the group have had study sessions at the begining of camp period on the following topics.

What makes the water polluted ?

What bad influences the water pollution will give to human being ?

How to prevent the water pollution ?

What can be done to recover the polluted river and streams ?

After that, the group took the sample of water at along the watercourse from Gang-gyo water reservoir to the lower reaches of the stream, and examined to find out what extent the water in Suwon get polluted. The group devised and set up a filter box. The group compared two methods of purification of polluted water, the filter box and the ion exchange resin box.

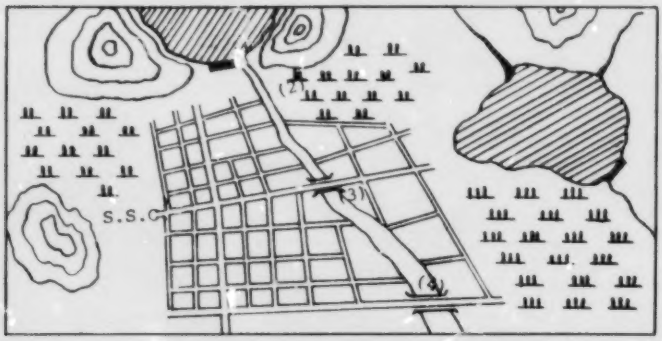
(Study method)

In order to find out "What makes water polluted ?" and "What bad influence the water pollution will give to human being ?" The group had collected the original ideas from members at the brain storming session.

a) Examination of water

(a) Gathering samples

The group considered that the water of the reservoir of Suwon is not polluted, because there is no factory near by and residence



area. The group gathered samples at four places along the route from reservoir to the lower reaches of the stream shown at the figure.

The group had examined the water by means of the following items. Before the examination the group learned the way of examinations by instructor.

a) Muddines b) Precipitation c) Smell d) Ph

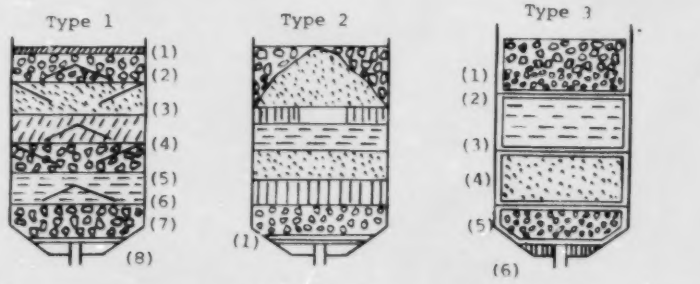
e) BOD (Quantity of solved oxigen of water)

f) Lead and copper ions in water g) Organic materials in water

h) Chloride i) Ammonium

(Device for purification fo polluted water)

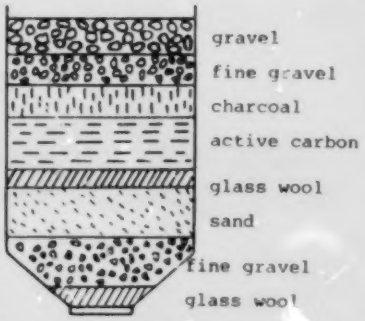
1) Filter box



(1) luffa
(2) fine gravel
(3) sand
(4) briquet ashes
(5) gravel
(6) charcoal
(7) gravel
(8) filter paper

(1) 3 layers of rags

(1) gravel
(2) gine gravel
(3) charcoal + active carbon
(4) sand
(5) fine gravel
(6) glass wool



Materials : Plastic tank(20ℓ), sand, pebbles, pieces of charcoal, active carbon, glass wool.

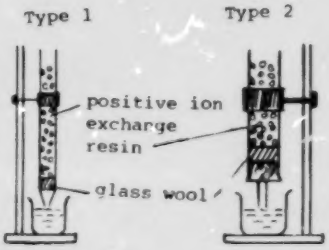
Procedure and setup : The group had deviced the above three types of filter boxes in order for examination the merits and demeri s of each box. After examination, the group fixed the following form of simple device for purification.

Expected effect : With this simple form of filter box, considerable amount of impurities, organic materials, bacilli as well as smell could be filtered. However, the heavy metal ions could not be filtered.

2) Positive ion exchange resin box

Materials : Burette, Glass tube (30mm dia), positive ion exchange resin, beaker, distilled water, NaCl.

Setup : The group had set up follwoing two types of boxes shown at the figure



Expected effect : Heavy metal ion, NH ion could be filtered

3) Negative ion exchange resin box

Materials : Burette, Glass tube, Negative ion exchange resin, beaker, distilled water

Setup : As mentioned at above figure

Expected effect : Most of the non-metal ion could be filtered.

(Results and Discussions)

The group reviewed their preceeding experiments and study books and made discussion as followings :

a) Sorts of polluted materials and damage

Polluted materials	Damager
Heavy metals(lead, copper, mercury, cadmium and the like)	Itai-itai disease, Minamata disease for men and deformed fishes
Agricultural chemicals	Disease caused by agricultural chemicals, accumulation in human body
Oils	Form oil films at the surface of water and decrease the photo-synthesis
Solid body wastes	Ammonia and methane gas by decomposition
Detergents	Intercept sun ray and oxygen by bubbles
Radioactive waste	Atomic disease
Chemicals(dyeing disinfectant)	Skin disease, cancer
Liquid wastes from mine	Change color of streams and bad effects to underwater living things
Plastic, vinyl	Bad effect to growth of water plants
Water temperature	Decrease the solubility of oxygens in water
Ph.	Bad effect to under water living things, if not suitable

b) Results of examination of water

Followings table is the results of examination by using the sample of water collected at five places.

Results of examination of water

	Water reservoir	Hwa-hong gate	Se-ryu bridge	Dai-wang bridge	Science Center
degree of muddy	floating a lot of big particles	no big particle, milky	many dregs, most cloudy	many dregs, rather cloudy	no impurity clean
precipitation	almost none precipitation but some floating	almost none	largest amount of blue and black precipitation	a little of dark blue precipitation	none of precipitation
smell	a little fishy smell	let of urine smell	severe cesspool smell	typical cesspool smell	a little bit of chemical smell
Ph	5	5	5-6	5	5
BOD	blue	blue	blue	blue	blue
copper, lead	no change	no change	no change	no change	no change
organic materials	no change before heating, but the color changed to violet afer heating	no change before, but the color changed to dyed after heating	immediately after heating the color changed to violet	light color, but the color changed to dyed after heating	violet, no change
chlorine	a little bit of precipitation	large amount of deposite, but less than Dai-wang	largest amount of ptrvipitation	large amount of precipitation	a least amount of precipitation
Ammonia	almost no change color	almost no change color	color changed to dense yellow	color changed to dense yellow, less than Se-ryu	almost no change color

(Discussion)

At the examination of muddy, Gang-gyo reservoir at the upper stream was clean, no color and no smell. The amount of chlorine was

least among the samples and ammonia was not detected. When the BOD was examined by means of methylene blue, oxygen was largest in amount.

The sample of water at the Se-ryu bridge was cloudier than that of Gang-gyo, less BOD, and larger amount of chlorine, ammonia but no lead and no copper.

From the examination results, we learned that the water would be polluted seriously by detergents, wastes and factory wastes etc. when it run down from up stream to down reaches.

In case of the water at Se-ryu bridge, it was most polluted, because of the down-town of Suwon city. Also we found that the water at Dai-wang bridge was less polluted than Se-ryu. It suggests that the water was purified naturally when it runs from Se-ryu to Dai-wang.

(Prevention of water pollution)

1) Prevent the cause of pollution

a) Waste water from houses should be permitted to run down after full purification.

b) Every factory should prepare the suitable purification system. At the same time, the temperature of waste water should be cooled before it runs into stream.

c) Prevent the damage of agricultural chemicals.

(1) To produce harm less agricultural insecticides and to eliminate insects by biological hormonal means.

(2) To produce the agricultural chemicals which are decomposed by natural purification.

(3) To prevent the damage by insects by means of natural enemy.

(4) To develop the method of lights and smells as extermination means instead of agricultural chemicals.

(5) To use the soft detergents.

(6) To throw away radioactive wastes from the earth to space.

2) Purification of polluted water

a) In order to pursue the natural purification, chlollera are cultivated in the stream.

b) At an upper stream, preservation tanks for polluted water are installed in several places. The water run through these tanks so as to purify step by step.

c) Lay out a drainage system, set up preservation tanks in several places as intermediate steps of purification.

d) At present, drinking water are sterilized by chlorine, but it is desirable to use ozone for sterilization.

(Conclusion)

Once polluted, it is very difficult to recover the water from the pollution, so prevention of pollution is more important.

The waste water from every houses should be let to run down after purification. At the same time, every factory should be equipped with purification systems to prevent the pollution by heavy metals, chemicals and temperature.

To prevent the pollution by agricultural chemicals and fertilizers it is required to develop new kinds of harmless chemicals. One must think of the ways to exterminate the harmful insects by ray or smells, if possible.

It is also desirable to improve the breed, to utilize natural enemies, to decrease the amount of agricultural chemicals, fertilizers and to substitute the soft detergents.

Biology group

Topics : How to increase food production

(Preface)

Because of population explosion and limitation of farm land, the food shortage is one of the most serious problem over the world. In Korea this year alone 17 hundred million dollars worth of grains are to be imported.

Collecting and putting together the ideas submitted at the brain storming sessions, the following experiments have planned.

Before the experiments, the group visited the Office of Rural Development in Suwon, and could get informations about the research on the cross breeding, agro-chemicals and fertilyzers.

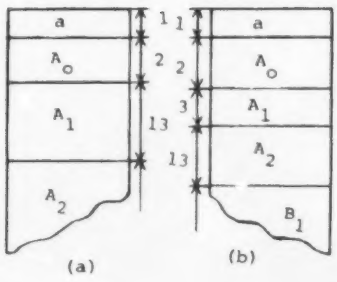
The group decided to study how to ameliorate soil which has left behind from the farmers as will as government officers, although it is an important task to be done quickly.

(Experiments)

The following experiments were done by the group. Before the experiments, a professor and teacher gave instructions in detail. The group took the soil samples from appropriate sites : one from the fertile and the other from poor site of mountain side, crop field and rice field respectively.

a) Methods followed
   (1) survey of soil profile
   (2) acidity of soil
   (3) measurement of water holding capacity
   (4) survey of humus in soils

b) Results
   (1) soil profile



soil sample taken from (b) rich site (b) poor site

a : layer of fallen leaves; leaves can be identified by unaid eye).

A_o: fallen leaves can not be identified by unaid eye.

A_1: color is blackness. Organic materials cooperated with mineral particles.

A_2: color is reddish brown.

(2) PH, water holding capacity, humus

Tabl 1 shows the soil data on the PH, water holding capacity and humus.

Table 1.

soil \ characters		acidity (PH)	water holding capacity (%)	humus (%)
mountain area	rich	6.2	2.62	3.81
	poor	5.9	2.54	2.65
crop field		6.1	0.86	3.51
rice field	high yield	6.0	3.03	4.36
	low yield	5.8	1.49	2.87

(Discussion)

a) Soil acidity : The soil acidity were almost near 6 by PH paper test. Generally speaking, plants grow well in the weak acid soil

(PH 6.1 - 6.5) and the neutral soil(PH 6.6 - 7.3).

By the Office of Rural Development, it is known the soil acidity of high yield rice fields is 6.3, while that of low yield rice fields is 5.5, however, the average acidity of soil from Japan and Korea were 5.8 and 5.5.

b) Water holding capacity : Water holding capacity of soil showed close relationship with the humus content and have affected the growth of plants and the population of micro-organism.

By the examination, holding capacity of soil tested were 30% in the high yield field, 14.3% in the poor rice field. Even in the soil of mountain areas, the holding capacity are 26.2% for rich soil, and 25.4% for poor soil.

c) Humus : The content of humus in soil was 3.81% in which the plants grow well, while that of poor soil 2.65%.

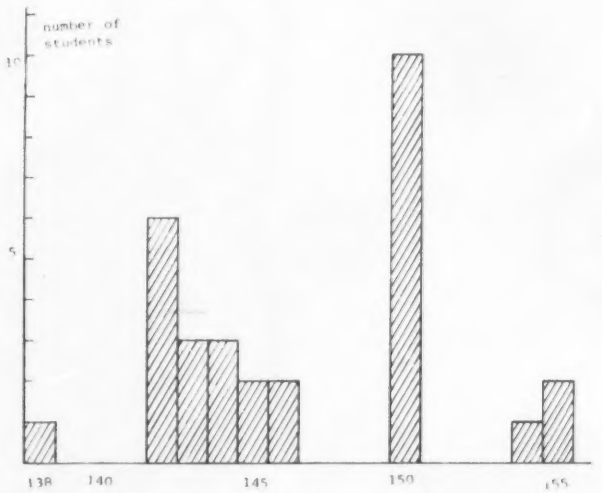
The content of humus in rich soil of high yield field was 4.38%, which was much higher than that of 2.87% in the soil of poor fields.

According to these results, the group have appreciated that the humus is the main factor of fertility, so it should be added to the field soil by means of composts.

3. The characteristics of the participating students in the camp

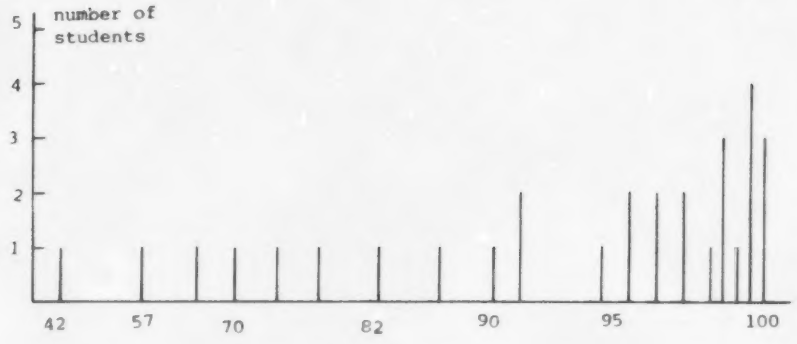
1) IQ distribution

According to the IQ distribution curve (next graph), the group could be considered as high IQ students.



lowest score of IQ : 138
mean vale : 147

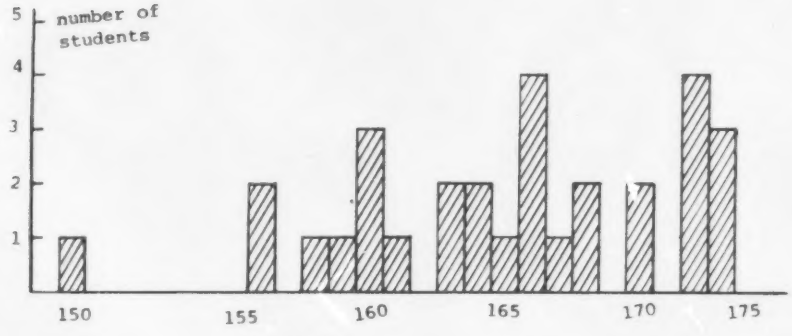
2) Creativity score distribution



The mean value of score of creativity is considerably high(89.5). But there are some participants of low creativity, therefore it is clear that all participants are not science gifted students.

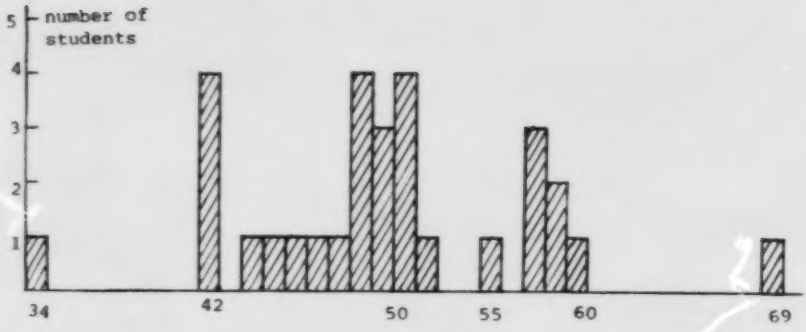
3) Physical aspects

a) Heights



The mean value of heights is 165.7cm. This value is rather higher than that of country average of 161.6cm. At the same time, the tallest is 173cm and the shortest is 149cm. There is a large variation in their height distribution.

b) Weights



The mean value of weights is 51.0Kg, same as the nation-wide average. There is a large variation in their distribution, also.

4) Health state

Generally speaking, the participants are all healthy. Only 5 of them had suffered from appendicitis, ozena, tonsillitis and otitis media.

It is founded that out of the participants, 10 students have O type blood. 9 students have B type blood and 11 students have A type. There is none of AB blood type.

5) Others

a) Home environments

Of the participants, 23 students live in their own house, 6 students in rented house of the key money system. The key money is substantial so that the interest could cover the rent. And 1 student monthly rent basis.

All students have a TV set and a radio in their house, 26 students have a refrigirator and 20 students have a home telephone. Most of them seem to make middle class living.

17 participants read one kind of newspaper and 5 read two kinds in their house. In case of books, 4 students have more than 50

volumes, 13 students have more than 100 volumes, 4 students have more than 200 volumes and 7 students have more than 500 volumes in their house.

b) Family concord

Parental concern to their children was questioned : high, middle and low. 24 students answered high, 5 expressed middle.

c) Taste for food

The taste for food of this group are not different from other students.

d) School life

Degree of satisfaction in school life was investigated on three level : satisfactory, medium and unsatisfactory. 10 students expressed their satisfaction with their school life in general, 17 students medium. Four students expressed satisfaction with their class lessons, 21 students medium.

e) Persons admired or hated

Of the participants, 23 students admire scientists such as Einstein, Edison, Newton and Nobel. In case of Korean, 17 students admire Great King Se-jong, admiral Lee Soon Shin. And 10 students admire politician such as Napoleon, Kennedy. Total number of indicated persons admired is 63.

16 students hate Kim Il Sung and his family, 7 students hate Japanese such as Ito Hiro Boomi, Toyotomi Hiteyoshi.

f) Subjects which he likes or dislikes

Of the participants, 13 students like mathematics, 10 students like science.

15 students expressed the reason that they can understand the principles of natural world and inquire into the principles, law etc.

6 students have no subject dislike. 10 students dislike technology, 3 students dislike physical education.

14 students dislike those subjects because they are not good at the subject. 2 students expressed that they dislike memorizing subject.

4. Self evaluation by participants

Problem solving experiences

Kim Ung Chai (physics)

We could get good ideas through brain storming sessions in analyzing the various problems in utilizing solar energy. The idea was that zig-zag formed pins could be attached to the usual collecting plate in order to eliminate the effect of sun's height.

Afterward we were informed that similar kind of a collecting plate with pins had been already made by others. However, our original attampt was to develop new form of pins and how to equip with pins in order to achieve higher efficiency than usual one.

By group works, we designed the new form of pins, zig-zag form, built up a model of collecting plate with these pins as well as a model of usual one for ourselves.

These two models were tested with electric light, instead of sun light becasue of cloudy weathers.

As results of our experiments, we could find that the temperature rise of the model with zig-zag pins was higher by 7.8 cal per an hour.

It was really wonderful experience for all of us. We shouted out and clapped our hands for joy when we could get a successful results after time consuming experiments. We could solve our problem by the effective, cooperative group works.

Social life experiences at the camp

Chung Kyun Ho (chemistry)

I really wanted to find out my giftedness for learning science and to have social experiences with other participants. Those were the reason why I applied to this summer camp.

In the begining of the camp, it was quite unfamiliar for me. I knew no other participants even in our group, and conversation was no smooth. However, I could make good friendship with other participants through well organized recreation or games which we had after daily camp program.

Every day at my free time, I washed my belongings : such as socks, shirts, school uniform and shoes. Doing this hard job, I could understand how much my mother works hard for me.

In the week end, we had a camping exercise at Gang-gyo resort near the water reservoir as a part of the camp program. On that night, we had all sorts of games under the guidance of instructors and had camp fire there. It was the first and most exciting experience for me in my life.

Every one was allowed to live freely in the camp. However, I would like to say that I felt the responsibility to my own behavior and I tried my best to observe the rules.

In conclusion, I would like to say that I could get fruitful experiences from a social life at the camp.

Joy of inquiry

Shin Yong Chul (biology)

We decided to study on soil-improvement in order to solve our problem through brain storming. The problem of soil improvement is the most fundamental for good harvest, but unfortunately, it had been neglected so far in our country.

In the begining of the camp, we heard that the group should find problems for ourselves and solutions without any help or advice from teachers. We were very much confused, because the way of learning was very different from the one we had so far.

It, gradually, became delightful to have our own experiment for

ourselves. While we were doing inquiry, we behaved just like a scientist and tried our best to find the solutions in our own original way.

Whenever we could get almost the same results as those of books, we felt self-confidence and pride for having a kind of research in science. From now on, I will try my best to inquire the natural world and to study science.

Impressions of the study visit

Shin Yong Cho (physics)

I had a chance to visit the Seoul National University and Korean Advanced Institute for Science and Technology in the camp period.

At SNU, Dean of College of Natural Science, Dr. Kho gave us a greeting and encouragement for studying science. We visited a physics lab. where laser and nuclear magnetic resonance experiments were operated. It was really a fascinating experience to see the mysterious red laser beams at the lab.

At KAIST, Director, Dr. Lee gave us a greeting and brief introduction to their works. We look at the display center and several labs. One of the most exciting ones was a very fine optical fibre developed by the research team which can transmit more than 3,000 copper lines by only one fibre.

Judging from this study visit experiences, I felt that Korea is not behind any other countries in some field of science and technology. In near future, I am quite sure that Korea will be able to take leading role in the world.

I was very much encouraged to be scientist by this visit tour. I made up my mind strongly to glorify the name of scientific nation, Korea in the future.

5. Teachers' evaluation

Physics teacher

Kwon Kee Joon (physics)

First of all, I would like to say that the participants were excellent. On the contrary to the worries in the begining of the camp, they had good knowledge in broad scope of science. They showed considerably high level of learning capability. And also they were full of intellectual curiousity and desire for problem solving in science.

I could say that the participants were excellent students among students of that age in Korea in studying science by liberal way of thinking with initiativeness.

However, unfortunately there were 3 boys who could not consider as science gifted students. Their creativity score are rather low and they were thought inferior to their colleagues.

The participants in the camp should be sellected by not only IQ score and their school records but also their creativity score.

The physics group had made a wonderful job during camp period. At the same time they learned a lot of things of high school physics level.

In this camp, I also had many chances to learn various things about gifted students and gifted education. From my personal experience at the camp, I could understand that scientific thinking and creativeness of students could not be developed by means of teachers' lecture only. I learned that my teaching method at school should be changed.

It is desirable to make school system flexible enough to adapt for gifted students. At the same time it is necessary to establish science high school for science gifted students as early as possible in Korea. This kind of science summer camp for gifted students should be continued next year on.

Chemistry teacher

Kim Jong Hee (chemistry)

The group had the first brain storming session on 19th August. Unexpectedly, many new ideas were submitted by the students, and heated and enthusiastic discussions followed. Though many of the ideas truned out to be impractical, they were really sensible ideas in principle. The examples are as follows:

No-pollution problem: The water is electrolyzed with solar energy. The product of this process, H_2, can be used as gaseous fuel in daily living. The water which comes from this combustion of H_2 can be used as drinking water.

Prevention of the pollution problems : Waste water of houses and factories should be run down through specially installed sewer and drainage system after pruified.

New kinds of insecticides should be developed to exterminate harmful insects by smell.

For disinfectant of water, ozone had better be used in stead of chlorine to eliminate carcinogen and so on.

The experiments began on 24th Aug. in accordance with the work schedule made by the group thinking of the group. On the contrary to their extensive and broad knowledge in science, they were poor in lab. skill. The reason is that they had few chances of experiment at schools.

I was strongly impressed by the fact that they could operate excellently various kind of advanced lab. equipments and tools with a few words of instruction, and they made successful experiments.

Almost every day they prepared competitively the lab. reports on the experiments and pre-study for next day experiments till midnight.

In conclusion, 9th grade gifted students could carry out successfully quantitative chemical experiments using ammonia and organic substances for themselves.

We should teach this kind of gifted students at regular 9th grade classroom seperately from ordinary students as far as possible. The method of gifted education should be studied by the teachers further.

Biology teacher

Song Yung Sik (biology)

The theme was how to increase food production. In the begining of the camp, the group had a study visit to the Office of Rural Development in Suwon and could find the fact that there have been intensive research for the improvement of plants, agricultural chemicals and fertilizers.

So the group made a following study plan concentrated on the soil properties :

1) Profile of soil structure
2) PH of soils
3) Water containing capacity in soils
4) Amount of humus in soils

The group took soil samples at the rice field, ordinary field and a forest for both rich and barren soils, in each case.

Lab. methods were taught by instructors. Students' attitude for lab. works were very sincere, earnest and eager. When the soil samples put into oven or electric furnace, it would take 3-4 hours for drying. In order to complete the same operation three times repeatedly, they had to work until 11 o'clock mid-night. They were sometimes dozing, while waiting for the drying. When they found the successful results after time consuming lab. works they were so pleased that the hardship they bore seemed to be payed very handsomely.

Looking at these scenes at the camp, I am sure that they can make great scientist in the future.

6. General evaluation

Chung Yun Tai

Originally the main purposes of this summer science camp for the gifted 9th grade students were to enhance their creativity and to accelerate their science learning through problem solving, as well as to train the teachers for gifted education. At the same time, we intended to find out various characteristics of the gifted students of the camp and to justify the necessity of special education for them.

It appeared too difficult to solve the problem for the 9th grade students, but they had finished successfully all the programme of the camp of 10 days' duration.

To solve the given problems, they collected all the ideas through brain storming sessions and planned work-schedule by group thinking. According to the plan, each group could solve the problem in a scientific way like a scientist. This kind of experience of problem solving are very important to participants. Some of the method used and laboratory operations for problem solving were somewhat above their grade levels.

I am sure that they could learn scientific knowledge and lab. skills of more advanced levels.

Judging by their responses or written comments by the participants, I believe that the students will take creative, scientific logical attitude towards any problems which they will confront with.

The visiting tour to the Seoul National University and Korean Advanced Institute for Science and Technology impressed them very much. Most of them decided their mind strongly for the improvement of science and technology in their future.

Through the social life of the camp, students developed much cooperative attitude. This is another good by-product of the camp.

The teachers in charge could have a teaching experiences for the gifted students for the first time and develop teaching skills to deal

with them.

In conclusion, this summer camp has brought a meaningful and fruitful experience for all of us. The followings are the recommendations based on these results:

1) Science camp of this kind should be continued in the form of extra-curricular activities.

2) Special measures should be developed for gifted students in regular schools.

3) Proper teaching programme should be developed for science gifted students in and out of school system.

Appendix

(Working schedule)

Physics group

Days	Activities
17	Registration of participants, orientation, creativity test
18	Opening ceremony, explanation on the theme, orientation on the study method
19	Study of related science books and literature, brain storming
20	Visit tour(SNU, KAIST), on-spot-study at solar house, Suwon
21	Special lecture(science and technology in future), set up working schedule
22	Design drawing of collecting plate, camping exercise at Gang-gyo
23	Camping exercise at Gang-gyo
24	Set up the models, PSSC ripple tank experiment
25	Set up the models
26	Experiments of developed models. Finalization of the group report
27	Presentation of the group report to the related authorities, closing ceremony

Chemistry group

Days	Activities
17	Registration of participants, orientation, creativity test
18	Opening ceremony, explanation on the theme, orientation on the study method
19	Brain storming, study of related science books and literatures
20	Set up working schedule, visit tour(SNU, KAIST)
21	Special lecture(science and technology in future), collecting water samples
22	Instruction of how to examine water by instructors, camping

	exercise
23	Camping exercise at Gang-gyo
24	Set up filter boxes, examination of water
25	Set up ion exchange resin boxes, examination of water
26	Discussion on how to prevent pollution, finalization of report
27	Presentation of the group report to the related authorities, closing ceremony

Biology group

Days	Activities
17	Registration of participants, orientation, creativity test
18	Opening cerenony, explanatkon on the theme, orientation on the study method
19	Study of related science books and literature, brain storming, visit to the Office of Rural Development, Suwon
20	Visit tour(SNU, KAIST), Experiment with indicators
21	Special lecture(science and technology in future), Survey of soil structure, collecting the soil samples
22	Examination of soil acidity, camping exercise at Gang-gyo
23	Camping exercise
24	Examination of water retaining power in soils, and humus in soils
25	Examination of Ph in soils, water retaining power, humus in soil samples
26	Review the experimental data, finalization of the group report
27	Presentation of the group report, closing ceremony